Resistance to Tarnished Plant Bugs in Cotton Varieties?

Fred Bourland
Glenn Studebaker
Tina Gray Teague

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Resistance to TPB in Cotton Varieties?

Major Insect Pests

Insect species have changed:

- **Boll weevil (eradicated in most U.S. areas)**
- **Heliothine complex (controlled by Bt cotton)**
- **Lygus species have become major problem.**

Improved resistance to Lygus spp. (especially tarnished plant bug) is needed.

Tarnished plant bug, *Lygus lineolaris* (Palisot de Beauvois)

TPB nymph in white flower

Tarnished Plant Bug -- feeding injury

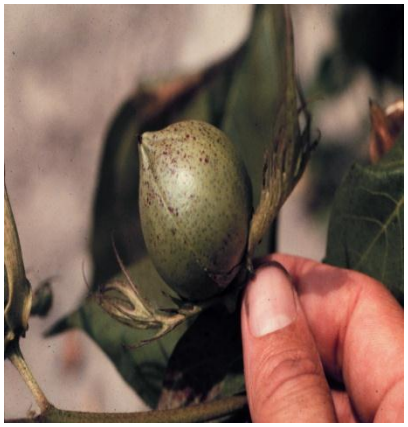
Morphological Traits Associated with TPB Susceptibility

Frego bract = Susceptible check

Partially resistant to boll weevil

Highly susceptible to plant bugs

Frego bract lines usually have ~90% dirty flowers while most non-Frego lines are <50%.



Phil Tugwell liked to jest, “The reason that Frego bract cottons appears to resist boll weevils is that after plant bugs get through, no self-respecting boll weevil would attack them!”

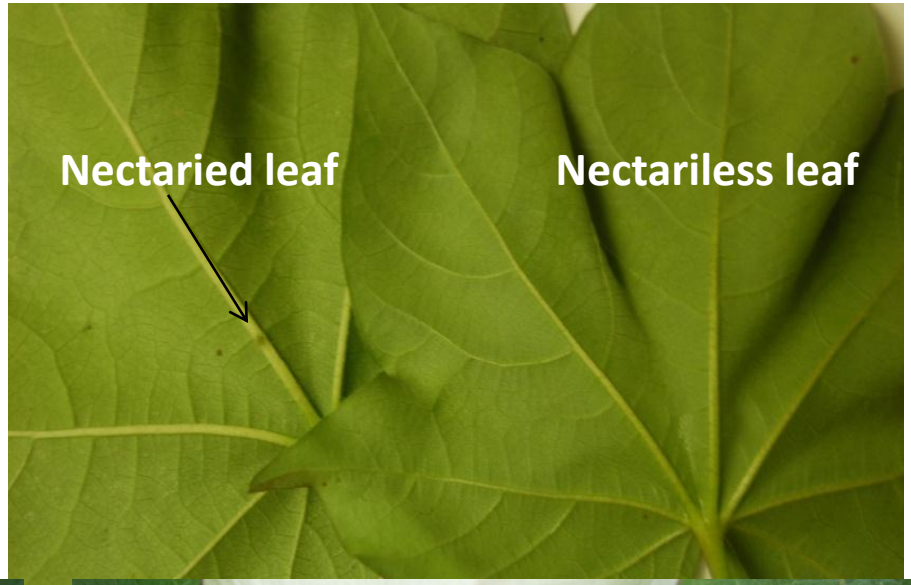
Morphological Traits Associated with TPB Susceptibility

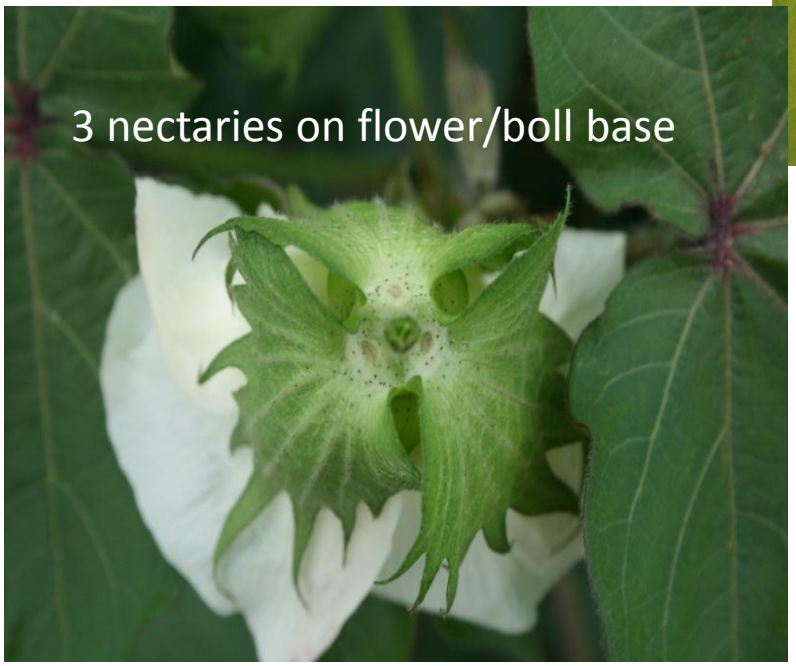
Okra & super okra leaf

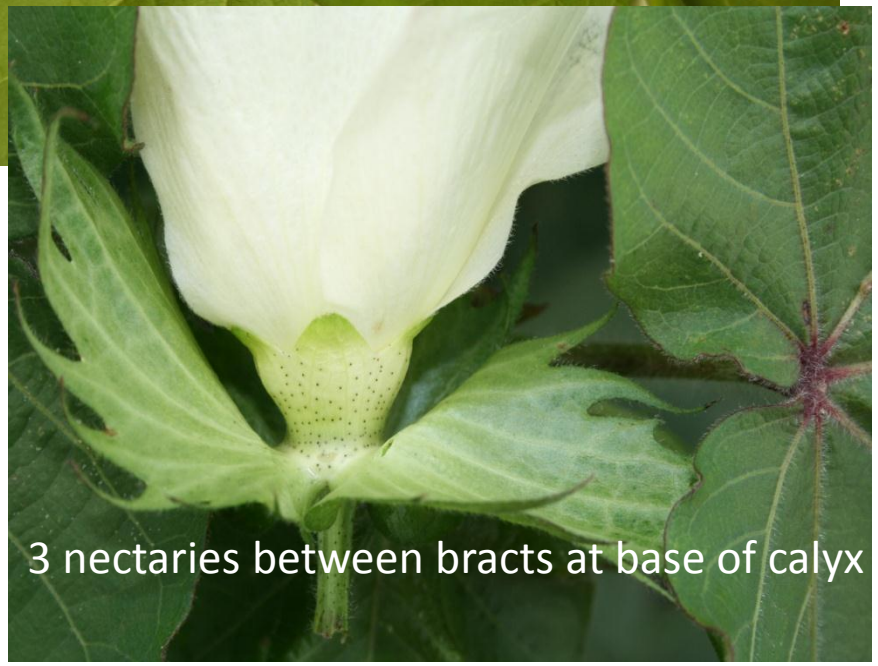
Glabrous (smooth) stem & leaf

Morphological Traits Associated with TPB Resistance

Nectaries normally found on cotton plants, provide food source for TPB.







Morphological Traits Associated with TPB Resistance

Nectariless

Entomological studies: TPB populations reduced in nectariless lines.

Isoline studies: Yield of nectariless line = yield of nectaried line.

Much breeding effort to develop nectariless varieties, but only three successful nectariless varieties have been released:

- **Stoneville 731N**
- **Stoneville 825**
- **DP 0935 B2RF**

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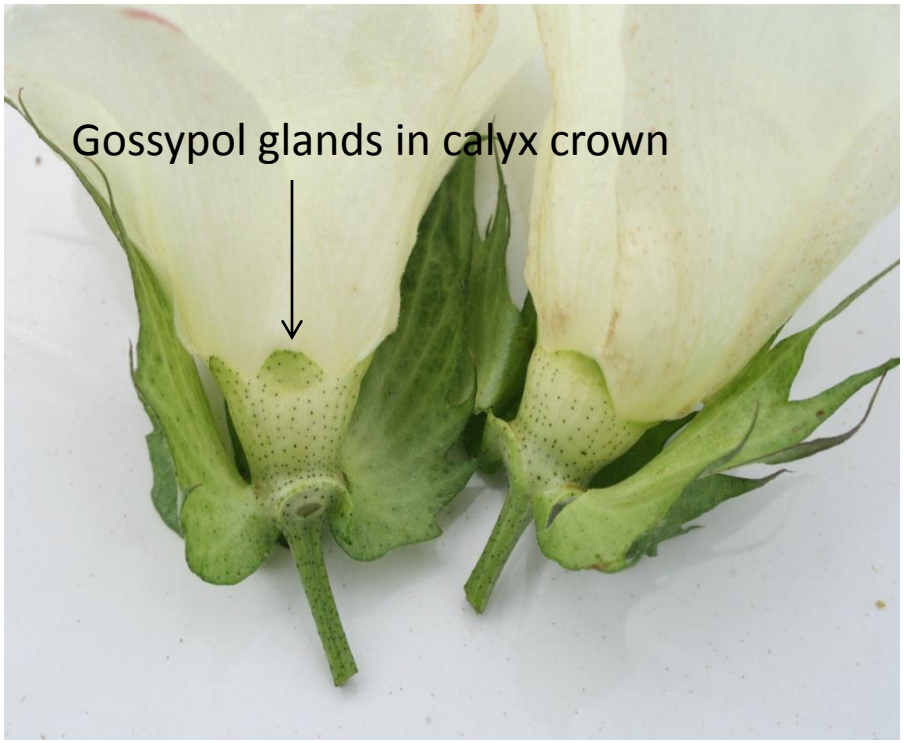
Morphological Traits Associated with TPB Resistance

Pubescent stems and leaves

High glanding types (lower preference)



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Morphological Traits Associated with TPB Resistance

Early maturity (escape or preference?)

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Resistance to TPB in Cotton Varieties?

Emerging Transgenic Technology

Likely to be available:

- Stacking of herbicide resistance genes.
- Resistance to other herbicides (Dicamba, 2-4D, HPPD).
- Additional constructs of Bt genes.
- ✓ **Resistance to *Lygus* species (plant bugs).**
- Drought tolerance gene for arid regions.
- Reniform nematode resistance.

Less likely to be soon available:

- Additional stress tolerance.
- Yield improvement genes.
- Fiber quality genes.
- Hybrid cotton to deliver transgenes.

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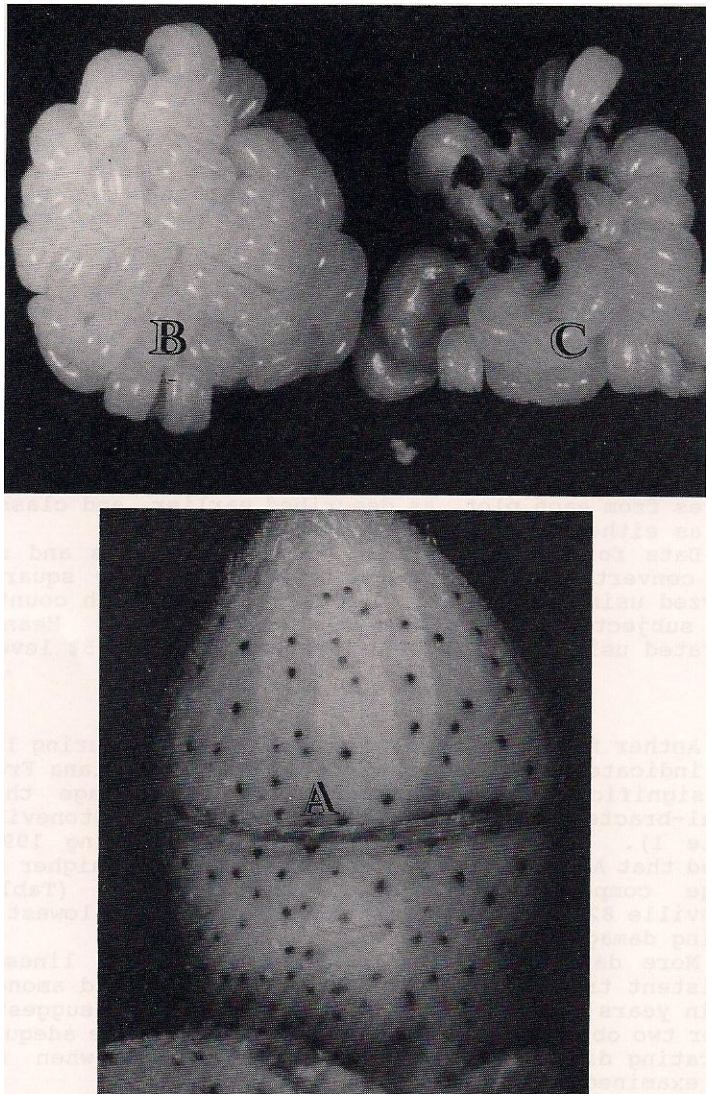
Square-Slicing Technique

Maredia, Tugwell, Waddle & Bourland. 1994. Southwestern Entomologist 19:63-70.

1. Random samples of 6-10 mm squares <u>having no boll weevil or worm damage</u>.
2. Slice each square across broadest section of bud (A), save apex.
3. Expose anthers in square apex by gently pressing with rolling motion between thumb and forefinger.
4. Examine intact anthers for discoloration - no damage (B); damaged (C).
5. Classify by % of anthers damaged or as % of squares/flowers damaged.



Resistance to TPB in Cotton Varieties?

"Dirty flower" Technique

Without boll weevil, examine white flowers & classify as zero, <50%, or >50% damaged anthers, then determine approximate % damage index (using a weighted mean).

OR - Examine white flowers & classify as undamaged or damaged.

Over several tests, found that "% damage index" and "% damaged" were highly correlated ($r > 0.95$).

Resistance to TPB in Cotton Varieties?

TPB Field Procedures

1. Plant highly susceptible check in 4-row strips leaving 12 rows between strips (field adjacent to corn is preferred).
2. About 3-4 weeks later (late May), plant small plot (1-row x 20 feet) tests in the 12 rows (1 replication/row). Include susceptible check(s) in each test.
3. No insecticides applied for TPB.
4. When TPB damage can be readily seen in flowers of susceptible (early August), initiate examination for “dirty flowers”.
5. Examine 6 white flowers/day for 5 to 8 days & record number damaged. Calculate one accumulative % dirty flowers over sampling days for each plot.

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Morphological Traits Associated with TPB Susceptibility

Yield & height variation

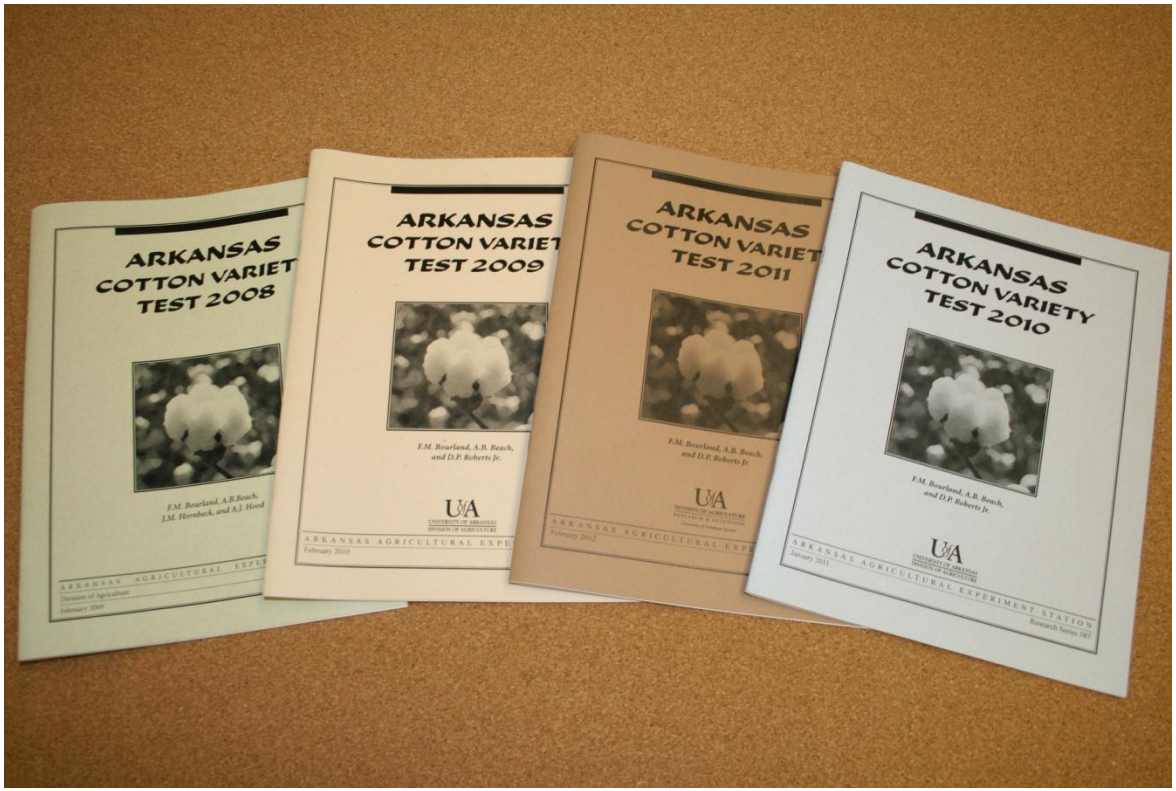
Tarnished plant bug, "% dirty flowers" for 25 entries in 2011 Main Arkansas Test

Variety	% dirty	% frego
ST 5288 B2RF	32	35
PHY 367 WRF	32	35
SSG UA 222	35	39
DP 1252 B2RF	35	39
DP 0912 B2RF	37	41
AM 1511 B2RF	38	41
DP 0920 B2RF	38	42
CT10624 B2RF	39	43
PHY 565 WRF	39	43
ST 4288 B2RF	40	44
DP 1133 B2RF	42	46
AM 1550 B2R	43	48
DG 2570 B2RF	43	48

Variety	% dirty	% frego
CG 3220 B2RF	45	50
DP 1028 B2RF	45	50
PHY 499 WRF	45	50
SSG HQ110	46	51
SSG HQ210	47	52
Ark 0219-15	49	54
ST 5458 B2RF	50	55
FM 1740 B2F	51	56
AM UA48	52	57
DG 2450 B2RF	54	60
PHY 375 WRF	61	67
Frego check 1	87	-
Frego check 2	94	-

LSD0.10 = **9.6**; C.V. = **30.3%**; R2*100 = **54.8**

Annual TPB data available at www://ArkansasVarietyTesting.com



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Tarnished plant bug, response over years (through 2010),
% “dirty flowers” expressed as % of Frego bract check

Older Varieties, rank out of 32

Variety	% Frego	Rank	Tests
DP0935ne B2RF	28	1	3
ST 5288 B2RF	28	1	3
DP 0924 B2RF	33	3	3
AM 1550 B2RF	34	5	4
ST 5458 B2RF	35	7	4
DP 174 RF	35	7	4
DP 393, ck.	36	10	6
FM 1740 B2R	37	12	3
DG 2570 B2RF	37	12	4
CG 3220 B2RF	38	16	4
PHY 375 WRF	40	23	4
PHY 315 RF	40	23	4

Newer Varieties, rank out of 32

Variety	% Frego	Rank	Tests
PHY 367 WRF	35	7	2
09R619 B2R2	38	16	2
DP 0920 B2RF	39	19	2
PHY 565 WRF	39	19	2
DP 1028 B2RF	39	19	2
DP 0912 B2RF	40	23	2
FM 1773 LLB2	44	27	2
BCSX 1010B2F	46	28	2
DP 1032 B2RF	46	28	2
PHY 569 WRF	46	28	2
DP 0949 B2RF	46	28	2
UA48	61	32	2

Tarnished plant bug, response over years (through 2011)
For 25 entries in 2011 Main Arkansas Test

% “dirty flowers” expressed as % of Frego bract check

Variety	% Frego	Tests
ST 5288 B2RF	34	4
PHY 367 WRF	37	3
AM 1511 B2RF	38	2
SSG UA 222	39	2
CT10624 B2RF	41	2
AM 1550 B2R	42	5
DP 1252 B2RF	43	2
ST 4288 B2RF	43	4
DP 0920 B2RF	44	3
PHY 565 WRF	44	3
ST 5458 B2RF	44	5
DP 0912 B2RF	44	3

Variety	% Frego	Tests
DG 2570 B2RF	45	5
CG 3220 B2RF	46	5
DP 1028 B2RF	46	3
FM 1740 B2F	48	4
DP 1133 B2RF	49	2
PHY 499 WRF	50	2
SSG HQ210	51	4
PHY 375 WRF	51	6
SSG HQ110	51	2
Ark 0219-15	55	2
DG 2450 B2RF	56	2
AM UA48	66	3

Response to Tarnished Plant Bug by Cotton Varieties in Large Plots at Keiser, AR, in 2012

Variety	TPB	Untreated yield, lb/a	Treated yield, lb/a	Treated – Untreated	No. of trts
ST 5288 B2RF	Res	949 e	1035 cd	87	2
SSG UA 222	Res	1074 bc	1187 a	113	2
PHY 375 WRF	Sus	844 f	1030 cde	182	5
AM UA48	Sus	973 de	1155 ab	182	4

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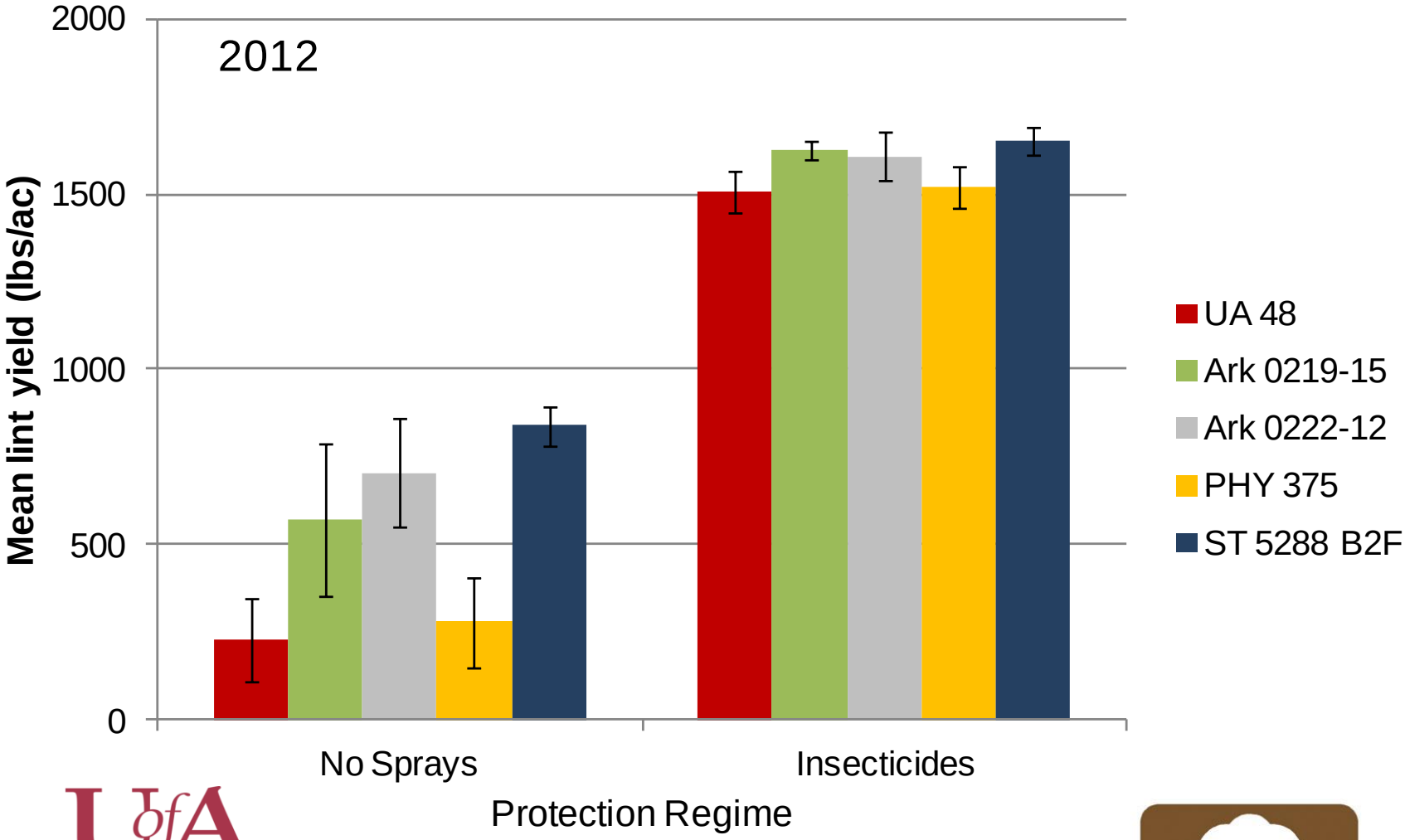
Response to Tarnished Plant Bug by Cotton Varieties in Large Plots at Keiser, AR, in 2012

Response to Tarnished Plant Bug by Cotton Varieties in Large Plots at Marianna, AR, in 2012



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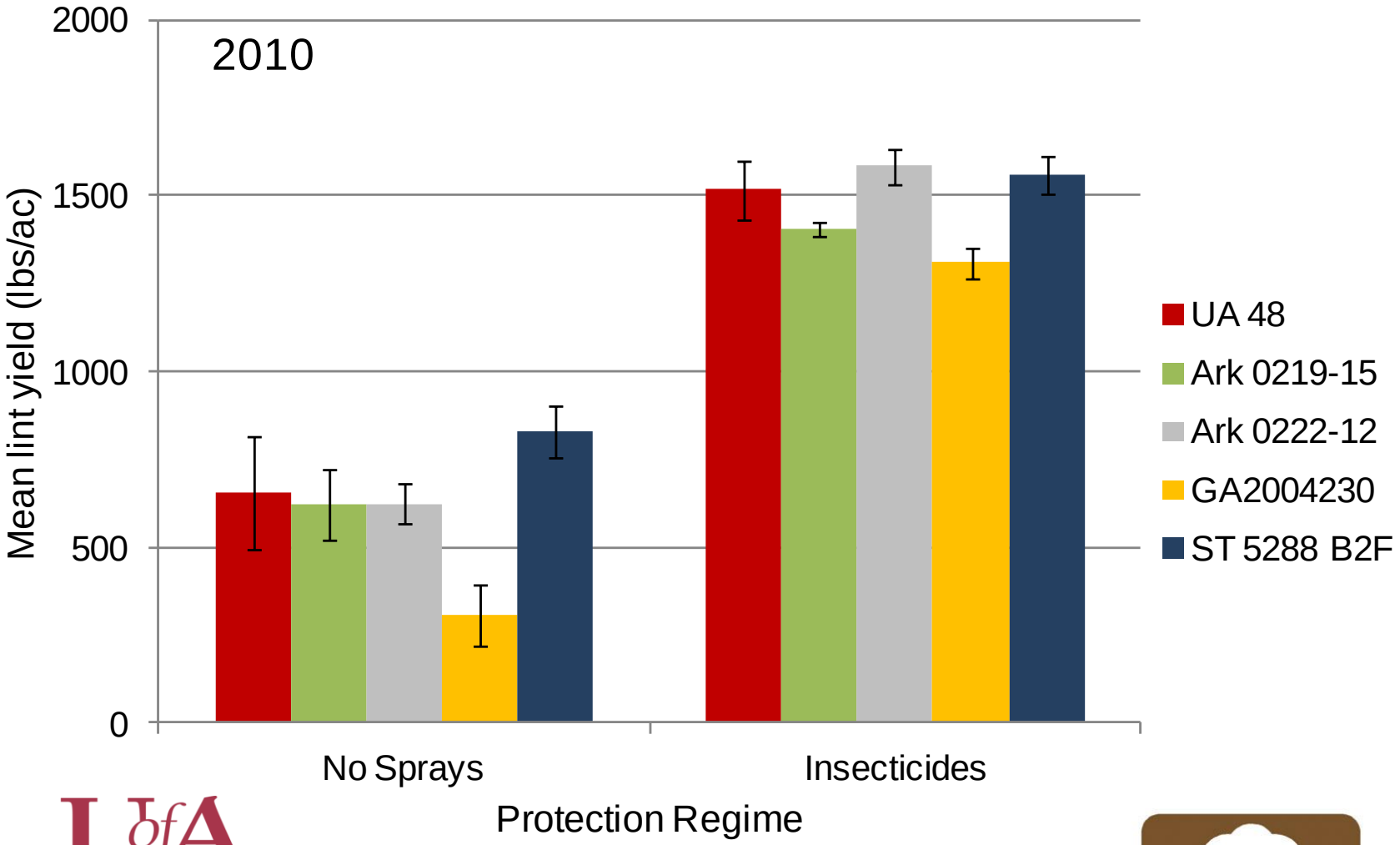
Response to Tarnished Plant Bug by Cotton Varieties in Large Plots at Marianna, AR, in 2010



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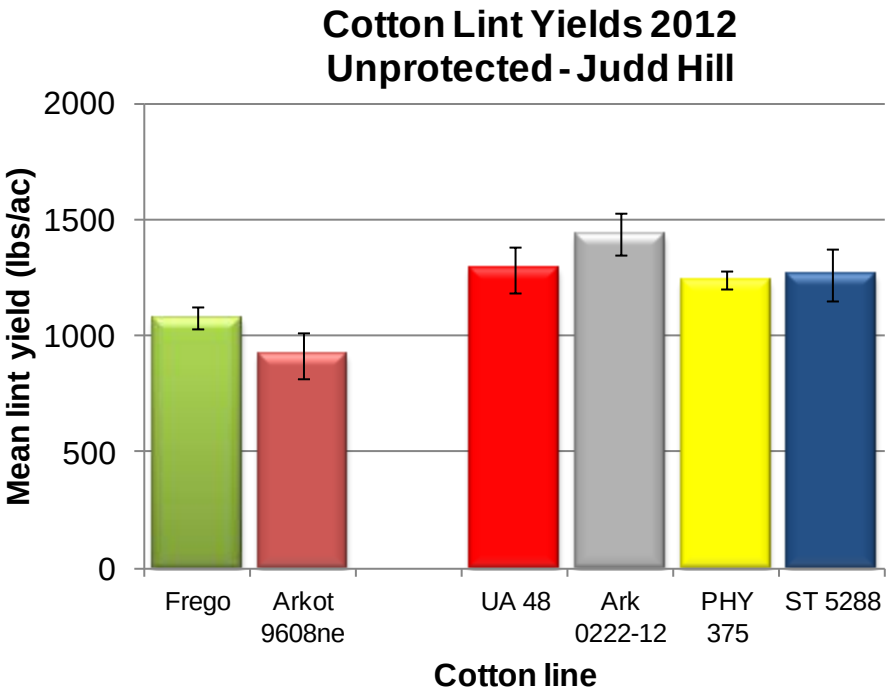
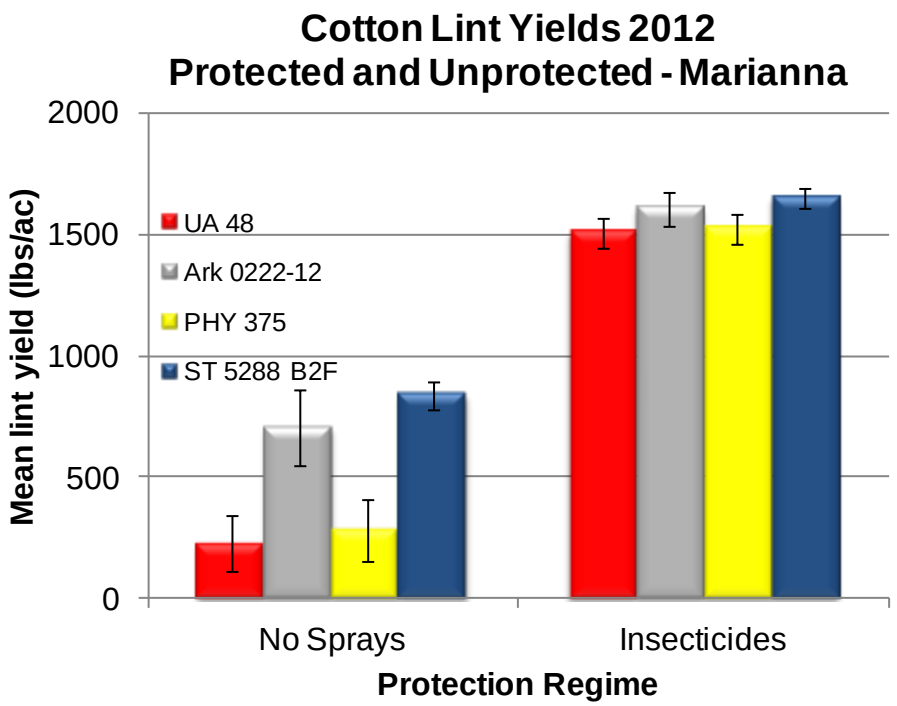
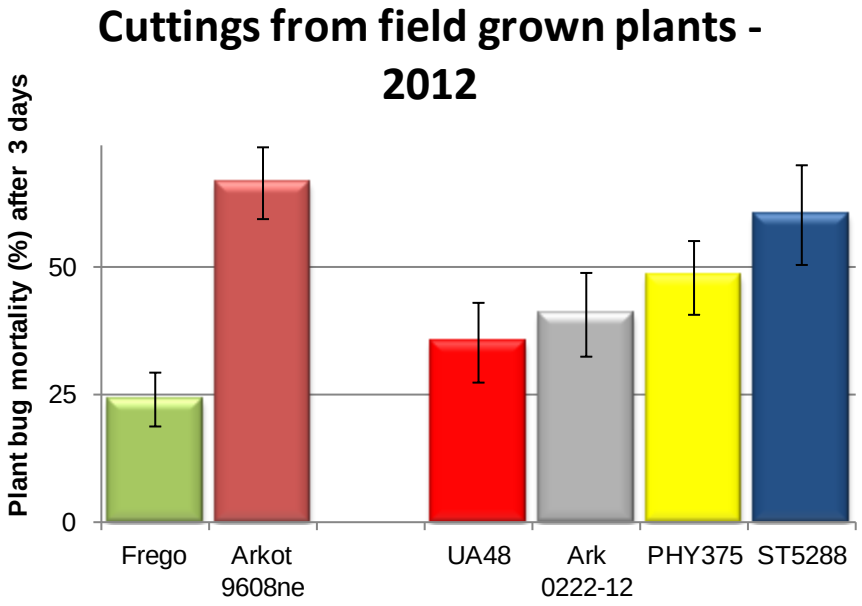
Terminal Cuttings from field grown plants

- **Laboratory feeding studies with TPB were performed with main stem terminal cuttings that included the upper 6 to 10 squaring nodes.**
- **Cuttings from each line were infested with either 3 newly hatched TPB nymphs. Plants were covered with sleeve cages.**
- **Assessed nymph survival after 3 days**


Cotton Lint Yields 2012
Unprotected - Judd Hill
Mean lint yield (lbs/ac)
2000
1500
1000
500
0
Frego
Arkot 9608ne
UA 48
Ark 0222-12
PHY 375
ST 5288
Cotton line


Cotton Lint Yields 2012
Protected and Unprotected - Marianna
Mean lint yield (lbs/ac)
2000
1500
1000
500
0
UA 48
Ark 0222-12
PHY 375
ST 5288 B2F
No Sprays
Insecticides
Protection Regime


Cuttings from field grown plants - 2012
Plant bug mortality (%) after 3 days
50
25
0
Frego
Arkot 9608ne
UA48
Ark 0222-12
PHY375
ST5288

Resistance to TPB in Cotton Varieties?

Conclusions

1. Variation in varietal response to TPB can be measured in small plots using the dirty flower technique.
2. TPB populations require more time to reach treatment threshold and inflict less damage on varieties that relatively low dirty flower %.
3. Nectariless and dense pubescence morphological traits confer some degree of TPB resistance, but similar levels can be found in some nectaried, glabrous types – suggesting a different mechanism of resistance.
4. A method to better evaluate TPB resistance on an individual plant basis is need to combine and enhance these mechanisms of resistance.

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